A 1960-1-U (A) 2/89

AMERICAN INSTITUTE OF PHYSICS

AIP REPORT

335 East 45th Street
New York, NY 10017-3483

EDUCATION & EMPLOYMENT
STATISTICS DIVISION

Tel. 212-661-9404

by Susanne D. Ellis
and Patrick J. Mulvey

AIP Pub. No. R-282.11

December 1988

EMPLOYMENT SURVEY 1987

There are many ways in which graduates approach their initial employment. To find out how new physicists and astronomers accomplish their transitions from "student" to "employee" and how they evaluate that transfer in retrospect, we conduct an annual Employment Survey. We schedule this survey during the winter, so as to allow six months to elapse between it and two student surveys conducted each summer. It is the summer surveys that identify the employment-oriented physics and astronomy graduates who form the population we target in the follow-up Employment Survey.

The diverse parameters that influence one's initial employment include degree level, choice of specialty, citizenship and geographic region, to name a few. A particularly relevant question for employment-oriented degree recipients is how much time they needed to secure suitable employment. The answers from physics degree recipients are summarized in **Figure I**, which presents four time periods during which graduates at each of three degree levels accepted their first positions. 'Postdocs' are excluded from the doctoral graduates so as to focus on potentially permanent positions comparable to those sought by the masters and bachelors. The first time period—less than 1 month—is intended to identify graduates who have positions already lined-up when their degrees were conferred. For the graduates of the class of 1987, almost half (44%) of both the bachelors and the masters but only 13% of the doctorate recipients fell into this category. Such a distribution suggests that doctoral graduates require more time to review their employment options.

Figure I. Time spent by 1986-87 physics degree recipients in securing employment.

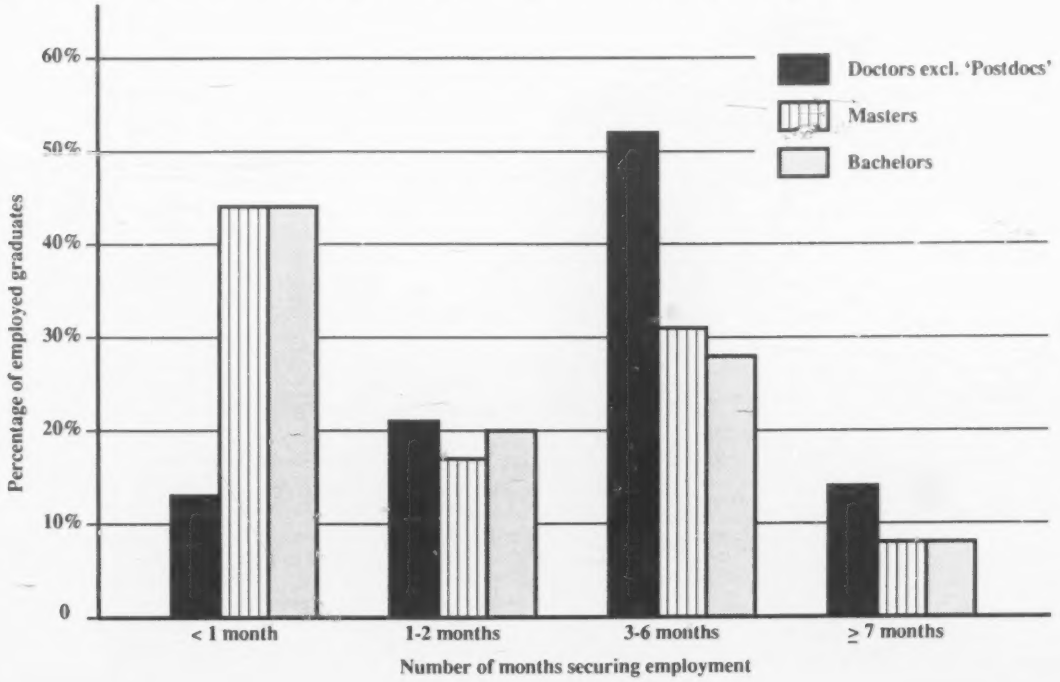

Table I. Changes in occupational status of physics degree recipients between the summer of 1987 and the following winter.

Employment status reported by physics degree recipients, summer 1987		Occupational status, winter 1987–88					
		'Postdoc' or student	Employment full-time permanent	Other	Not employed and seeking	Total N	Total %
Doctors							
Newly accepted employment		7	114	–	1	122	25%
Continuing employment		5	8	–	–	13	3
'Postdoc'		260	22	–	–	282	59
Return to foreign country		5	7	–	–	12	3
Other		5	–	–	1	6	1
Not empl. and seeking		23	18	2	–	43	9
Total respondents	N	305	169	2	2	478	
	%	64	35	0.4	0.4		100%
Masters							
Newly accepted employment		–	87	–	1	88	58%
Continuing employment		–	30	–	1	31	20
Return to foreign country		–	1	–	–	1	1
Other		1	7	–	2	10	7
Not empl. and seeking		–	13	–	9	22	14
Total respondents	N	1	138	–	13	152	
	%	–	91	–	9		100%
Bachelors							
Newly accepted employment		7	302	2	5	316	39%
Continuing employment		2	95	–	4	101	13
Military service		2	120	–	3	125	15
Summer employment		6	69	–	14	89	11
Undecided		4	30	5	4	43	5
Not empl. and seeking		7	90	–	39	136	17
Total respondents	N	28	706	7	69	810	
	%	3	87	1	9		100%

Introduction to the job market can be a gradual process for some new graduates; consequently, a look at the changes in occupational status during the six-month period between surveys conveys important information. **Tables I** and **II** present those changes for the physicists and astronomers respectively and include U.S. as well as foreign degree recipients. Each table has three parts, which correspond to the three degree levels. The first column of each table lists the occupational status as reported by the physics and astronomy graduates in the summer of 1987. Thus from **Table I** we note that 28% of the doctorate recipients secured permanent employment and 59% had accepted 'postdocs'; approximately 9% were still seeking employment. Six months later, during the winter of 1987–88, we note that all the unemployed had accepted positions while two new physicists appeared to be between jobs.

Approximately one third of the 600 physics master's degree recipients in the class of 1987 studied for that degree on a part-time basis while working full-time and continued their employment after graduation. Only 31 of the respondents to the Employment Survey fell into this category and all except one reported no changes in their occupational status. Of the masters who identified themselves as unemployed in the summer survey, a majority secured positions during that six-month period.

When referring to employment-oriented physics bachelors, we need to add a qualifying statement: Approximately one-fifth of that group intends to work for only one year while deciding which graduate studies to pursue. It appears from **Table I** that 3% of the 810 respondents exercised that option earlier than expected. Most of the bachelors who were either undecided or unemployed at the time of the summer survey, had secured employment by December 1987. However, the percentage of bachelors still seeking employment (9%) was the same as that of the previous year.

Three-quarters of the new astronomers traditionally accept postdoctoral fellowships, and **Table II** indicates that the class of 1987 is no exception. Almost all of the astronomy masters and bachelors appear to have found suitable employment.

Table II. Changes in occupational status of astronomy degree recipients between the summer of 1987 and the following winter.

Employment status reported by astronomy degree recipients, summer 1987.		Occupational status, winter 1987–88 'Postdoc' or student	Employed	Not employed and seeking	Total N	Total %
Doctors						
Regular employment		2	8	–	10	22%
'Postdoc'		31	2	–	33	73
Not empl. and seeking		1	1	–	2	5
Total respondents	N	34	11	–	45	
	%	76	24	–		100%
Masters						
Regular employment		–	9	–	9	64%
Will be seeking		–	2	–	2	14
Not empl. and seeking		–	2	1	3	22
Total respondents	N	–	13	1	14	
	%	–	93	7		100%
Bachelors						
Regular employment		1	4	–	5	46%
Summer employment		–	3	–	3	27
Not empl. and seeking		–	2	1	3	27
Total respondents	N	1	9	1	11	
	%	9	82	9		100%

An established employment pattern throughout the 1980s has been one where physicists whose dissertations were based on experimental work were more likely to be offered potentially permanent positions; theoreticians, on the other hand, were more likely candidates for 'postdocs.' **Table III** relates the dissertation research to the types of employment and distinguishes between U.S. and foreign graduates. While both U.S. and foreign degree recipients recorded a gradual shift toward experimental research since 1984, it is the foreign graduates who benefitted more from the increasing demand for doctoral physicists. For example, **Table III** shows that 29% of the foreign experimentalists had secured potentially permanent positions thereby indicating an eight percentage-point increase over the previous year.

Table III. Occupational status of experimental and theoretical physicists by type of dissertation research, 1986–87.

Occupational status		Experimentalists U.S.	Foreign	Sub-total	Theoreticians U.S.	Foreign	Sub-total	Total
Full-time employment		41%	29%	38%	45%	13%	28%	35%
'Postdoc'		59	71	62	54	86	71	64
Not empl. and seeking		–	–	–	1	1	1	< 1
		100%	100%	100%	100%	100%	100%	100%
Total	N	254	85	339	65	74	139	478
	%			71%			29%	100%

Table IV. Characteristics of postdoctoral and full-time employed physics and astronomy doctorate recipients, 1986–87.

Physics			Astronomy		
Characteristics	'Postdocs'	Full-time employed	'Postdocs'	Full-time employed	Characteristics
Sex					Sex
Female	10%	9%	23%	18%	Female
Male	90	91	77	82	Male
Age					Age
26 or younger	6%	3%	3%	–	26 or younger
27 years	8	10	24	9%	27 years
28 years	17	17	9	9	28 years
29 years	14	18	27	28	29 years
30 years	14	12	3	9	30 years
31–32 years	22	17	24	27	31–32 years
33 or older	19	23	10	18	33 or older
Citizenship					Citizenship
U.S.	59%	81%	79%	82%	U.S.
Foreign	41	19	21	18	Foreign
Type of research					Type of research
Experimental	68%	77%	68%	73%	Experimental
Theoretical	32	23	32	27	Theoretical
Major subfield of dissertation					Major subfield of dissertation
Astrophysics	3%	9%	9%	9%	Astrophysics
Condensed matter	34	34	35	27	Cosmology/extragalactic/ quasi-stellar objects
Electron/atomic/molecular	9	7			
Elementary particles	15	14	6	9	Galactic structure/stellar motions
Mathematical physics	7	7	24	9	Stellar atmospheres and spectra/ stellar evolution/solar and stellar interiors
Nuclear physics	11	6			
Plasma/fluids	7	8			
			12	18	Interstellar matter & gaseous nebulae
			9	9	Solar systems
Median monthly salary	$2100	$3500	$2000	$2300	
Number of respondents	305	169	34	11	

Table IV presents six characteristics of the doctoral physicists and astronomers and relates them to the types of employment they accepted. To highlight those characteristics that changed significantly, let us compare our current data with those recorded for the 1980 graduates. We plan to limit this discussion to the physicists because the number of astronomers is comparatively small. Thus we find that physics 'postdocs' have doubled in number, included twice the proportion of women, were getting older and include over 40% foreign graduates compared with 26% in 1980. The types of dissertation research have changed less drastically. New physicists who accepted potentially permanent employment decreased in number, but their characteristics remained basically unchanged. We added salary information to **Table IV** this year for the first time.

Foreign doctoral graduates are not the only contributors to the increase in physics 'postdocs'. Since 1985 a larger number of U.S. degree recipients also chose 'postdocs' that allow them to pursue special research interests for a limited time while the market for new doctoral physicists becomes even more favorable. The initial employment trend, since 1977, is depicted in **Figure II** by three representative years for which the total number of physics doctorates granted were 1,000, 900, and 1,100 respectively.

Another comparison between 'postdocs' and graduates with potentially permanent positions is presented in **Table V** which focuses on the subfield mobility experienced by each group. The first column of the table lists the major dissertation subfields and matches them with the subfields associated with the physicists' initial employment. Thus we find large percentages along the diagonal of the upper portion of the table which shows that postdoctoral fellowships are offered in the same subfield. By contrast the lower half of **Table V** illustrates the adaptability of new physicists whose potentially permanent positions are spread among a larger number of specialties; the optics/laser physicists appear to form the exception.

Figure II. Changes in the type of employment accepted by new physicists in the U.S., 1977, 1982, 1987.

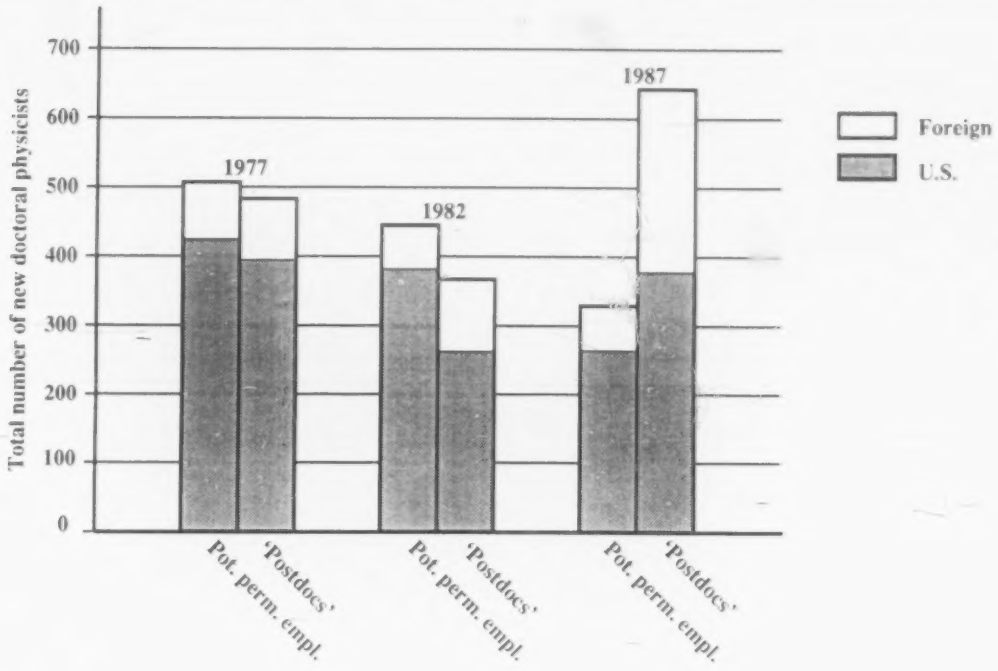

Table V. Subfield mobility of new doctoral level physicists, 1986–87.

Major subfield of dissertation	Subfields of 'postdoc'							Total respondents
	Astrophysics	Condensed matter	Electron/ atomic/ molecular	Elementary particles	Mathematical physics	Nuclear physics	Other	
Astrophysics	100%	–	–	–	–	–	–	18
Condensed matter	–	84%	2%	–	1%	–	13%	104
Electron/atomic/molec.	–	–	78	4%	–	–	18	27
Elementary particles	–	2	–	85	2	2%	9	47
Mathematical physics	–	5	5	5	67	–	18	21
Nuclear physics	3	–	3	3	–	84	7	32
								249

Major subfield of dissertation	Subfields of potentially permanent employment									Total respondents
	Condensed matter	Education	Elec./ atom./ molec.	Elem. part.	Nuclear	Optics	Plasma/ fluids	Applied physics	Other	
Condensed matter	64%	7%	–	–	–	5%	–	10%	14%	58
Electron/atomic/molecular	–	18	27%	9%	–	18	–	–	28	11
Elementary particles	4	4	–	42	4%	–	–	8	38	24
Nuclear physics	10	10	–	–	50	10	–	–	20	10
Optics/lasers	–	–	–	–	–	94	–	–	6	16
Plasma/fluids	–	7	–	–	–	–	64%	7	22	14
										133

Table VI. Employment with potential permanence accepted by 1986–87 doctorate recipients.

		Type of employer						Total	
		Univ.	Coll.	Industry	Gov't.	FFRC	Nonprofit org.	N	%
Subfield of Ph.D	Condensed matter	6	4	36	3	5	1	55	34
	Electron/atomic/molec.	–	2	5	2	–	1	10	6
	Elementary particles	7	2	8	2	5	–	24	15
	Math. physics	3	1	3	–	1	2	10	6
	Nuclear physics	3	1	4	1	1	–	10	6
	Optics/lasers	2	–	11	1	–	1	15	9
	Plasma/fluids	4	–	7	1	2	–	14	9
	Other	8	2	10	3	–	–	23	14
Work activity	Teaching	6	11	1	–	–	–	18	11
	Research	23	–	23	6	9	4	65	41
	Res./dev./des.	4	1	54	7	4	1	71	44
	Other	–	–	6	–	1	–	7	4
Physics related work	Same subfield	25	1	41	9	9	3	88	55
	Different subfield	6	11	24	3	4	2	50	31
Unrelated to physics	Research-oriented	2	–	4	1	1	–	8	5
	New area	–	–	10	–	–	–	10	6
	Other	–	–	5	–	–	–	5	3
Interested in a job change	Yes	11	6	11	5	–	2	35	22
	No	17	5	62	6	13	3	106	66
	Unsure	5	1	11	2	1	–	20	12
Starting salary	Monthly median	$2780	$2000	$3750	$3400	$3900		158	$3500
Total respondents	N	33	12	84	13	14	5	161**	
	%	21	7	52	8	9	3		100%

*Insufficient data.
**Eight new doctoral physicists began their employment outside the U.S.

Table VII. Characteristics of 1986–87 physics masters related to the type of employment secured.

		Type of employer						
Characteristics		Ed. inst.	Industry: manuf.	Industry: service	Gov't. incl. milit.	Other	Not empl. and seeking	Total
Sex	Female	17%	–	33%	13%	33%	15%	14%
	Male	83	100%	67	87	67	85	86
Age	24 or younger	8%	4%	7%	6%	33%	23%	7%
	25–26 years	21	43	27	7	33	46	24
	27–28 years	17	14	27	15	–	8	20
	29–30 years	8	4	13	59	–	8	25
	31 or older	46	35	26	13	34	15	24
Citizenship	U.S.	79%	96%	93%	100%	100%	100%	94%
	Foreign	21	4	7	–	–	–	6
Type of graduate inst.	Public	79%	82%	73%	80%	67%	70%	77%
	Private	21	18	27	20	33	30	23
Type of employment	Physics related	96%	86%	87%	96%	67%	–	90%
	Unrelated to physics	4	14	13	4	33	–	10
Major subfield of degree	Applied physics	8%	14%	14%	13%	–	10%	12%
	Condensed matter	25	25	7	4	–	15	15
	Cross discip.	8	10	10	21	–	–	10
	Optics	4	30	33	25	33%	40	25
Major work activity	Res./dev./des.	17%	86%	67%	67%	100%	–	65%
	Data analysis	3	7	27	8	–	–	10
	Teaching	80	–	–	13	–	–	20
Median monthly salary		$1850	$2830	$2710	$2100	*	–	$2400
Total		20%	35%	15%	20%	10%		100%

*Insufficient data.

Tables VI through **X** present more detailed information on the newly-employed physicists by relating pertinent characteristics to each of the major types of employers. **Table VI** focuses on doctoral physicists who had accepted potentially permanent positions and on employment characteristics not included in **Table IV** for that group; the subfields of the dissertations are the exception. Industry continues to be the largest employer for that group; by examining those who reported "physics-related work", more new physicists in industry accepted positions in their subfield than the number who changed subfields; the reverse was true in the previous year. To be more specific, among the 1987 graduates, those whose dissertation specialties were in optical lasers, plasma physics or crystal structure had accepted positions in industry in the same subfield. In fact, there was a notable increase in those who were both trained and working in optical lasers. On the other hand, new physicists who had specialized in cryogenics or elementary particles were obliged to work in more interdisciplinary areas in industry. One year earlier the new physicists from varying backgrounds had begun to work in optical lasers while many others described their initial industrial employment simply as "applied physics." The fourth characteristic measures the degree of satisfaction these new physicists experience. In answer to whether they are interested in changing jobs within the next two years, two-thirds of them replied "no," a proportion that has not changed in recent years. And for those employed in industry, the proportion not interested in a job change was even higher.

Background characteristics as well as those pertaining to the current employment of new physics masters are related to three specific types of employers in **Table VII**. The earlier statement in this report, that physics masters study for that degree on a part-time basis while working full-time, is reflected in both the age distribution as well as the industrial salaries. Many of the new masters look back on five years of experience when their degrees were conferred. A change from the previous year indicates that a higher proportion of physics masters who were employed by a service industry described their employment as physics-related.

As the largest group of respondents to this follow-up survey, the physics bachelors lend themselves to a more detailed analysis of their initial employment than did the physics masters. Thus **Tables VIII** and **IX** both focus on the employment of physics bachelors but with a different emphasis. **Table VIII** presents eight characteristics that are influential in determining the types of positions bachelors accepted while **Table IX** examines employer characteristics best shown in terms of horizontal percentages.

From **Figure I** we saw that two-thirds of the physics bachelors secured initial employment within a two-month period; **Table VIII** elaborates on those data by listing the methods used to secure employment and the number of job offers received. Compared to the previous year, more bachelors were obliged to accept work that was unrelated to physics, caused in part by a notable shift from manufacturing to service industry positions. The distribution of work activities indicates a nine percentage-point increase in research, development and design work.

Table VIII. Characteristics of 1986–87 physics bachelors related to the type of employment secured.

Characteristics		Type of employer: Sec. school	Coll./ univ.	Industry manuf.	Industry serv.	Civil. gov't.	Military service	Nonprf. org.	Other	Not empl.	Total N	Total %
Sex	Female	35%	12%	18%	20%	31%	9%	29%	25%	14%	155	19
	Male	65	88	82	80	69	91	71	75	86	655	81
Age	22 or younger	40%	34%	23%	36%	40%	69%	43%	50%	42%	329	40
	23 years	23	29	29	28	31	10	21	14	20	191	24
	24–25 years	21	10	21	19	12	14	29	17	22	145	18
	26 or older	16	27	27	17	17	7	7	19	16	145	18
Type of employment	Physics related	88%	68%	64%	38%	65%	35%	79%	50	–	371	52
	Unrelated to physics	12	32	36	62	35	65	21	50	–	342	48
Number of job offers	1	52%	80%	56%	52%	64%	84%	43%	75%	4%	438	61
	2	27	15	23	25	16	11	43	25	–	144	20
	3	21	5	21	23	20	5	14	–	–	136	19
Region of employment	Northeast	28%	25%	27%	31%	25%	–	46%	–	–	164	28
	Southeast	18	12	6	17	30	–	–	25%	–	85	14
	Central/Mountain	52	38	34	40	22	–	46	25	–	219	37
	Pacific	2	25	33	12	23	–	8	50	–	124	21
Major work activity	Res./dev./des.	–	58%	67%	38%	62%	10%	50%	13%	–	301	41
	Data analysis	–	15	13	21	13	8	7	–	–	95	13
	Teaching	100%	10	–	1	7	2	14	–	–	66	9
Primary method which secured employment	Univ. placement	30%	5%	14%	12%	19%	–	21%	–	–	83	12
	Resumes	45	22	35	36	26	5%	29	–	–	195	27
	Contacts/faculty	20	44	29	31	30	5	36	25%	–	178	25
	Military	–	–	–	–	1	86	–	–	–	123	17
Level of experience	Newly accepted	100%	88%	88%	93%	92%	15%	79%	50%	–	656	92
	Cont. employment	–	12	12	7	8	85	21	50	–	57	8
Total respondents	N	48	41	182	193	86	143	14	36*	69	810	
	%	6	5	22	24	11	17	2	4	9		100%

*This total includes 28 respondents who chose graduate study after investigating the job market; only the first two characteristics apply to them.

Table IX. Selected characteristics of physics bachelors that affect their employment, 1987.

Characteristics		Type of employer: Sec. school	Coll./ univ.	Industry: manuf.	Industry: serv.	Civil. gov't.	Military	Nonprf. org.	Other	Not empl.	Totals: %	Totals: N	%
Sex	Female	11%	3%	21%	25%	17%	8%	3%	6%	7%	100%	155	19
	Male	5	6	23	24	9	20	2	4	9	100	655	81
Type of bachelor's institution	Public	6%	4%	25%	20%	10%	21%	2%	4%	8%	100%	467	58
	Private	6	6	19	29	12	13	1	4	10	100	348	42
Type of degree	BS	5%	5%	23%	21%	10%	20%	2%	5%	9%	100%	599	74
	BA	8	6	22	32	11	9	2	1	9	100	211	26
Median monthly salary		$1410	$1650	$2240	$2000	$1960	$1590	$1500	$2000	–	All empl. $1900		

Table X. Median monthly salaries paid by civilian employers to physics bachelors, 1987.

N = 481	Work activity: Res./dev./ design	Data anal./ progr.	Technician/ res. asst.	Teaching	Tech. writing/ mrktng.	Nonphysics prof'l work	Skilled labor	Other	All empl. comb.
Salary	$2330	$2000	$1700	$1500	$1900	$1650	$1300	$1470	$1980
% respondents	37	15	15	10	3	7	2	11	100%

As the proportion of women among the employment-oriented physics bachelors increases, **Table IX** shows more clearly than **Table VIII** that they are less likely to be unemployed, equally accepted by industry and more likely to be employed by secondary schools and the civilian government than their male counterparts. Other observations evident from **Table IX** are that the expanding service industry employs proportionately more physics bachelors from private than public institutions and favors graduates with arts rather than science degrees.

Since the salaries of physics masters are shown by type of employer, we included the median salaries of physics bachelors in **Table IX** in order to facilitate comparisons between the two groups. However, a more relevant presentation of bachelors' salaries is to relate them to the different work activities bachelors report and exclude the military. Thus **Table X** focuses on civilian employment and shows a combined median salary of $1980/month which compares with a combined median of $1900/month when the military is included. Other parameters that influence salaries are whether or not the new bachelors are engaged in defense work. For example, physics bachelors who worked for defense contractors reported a median of $2360/month compared with an $1800/month median for those not involved in defense work.

Table XI. Time spent by 1986–87 astronomy graduates in securing employment.

	Number of months spent seeking employment: ≤2 months	>3 months	Total respondents
Astronomy bachelors	7	4	11
Astronomy masters	8	6	14
Astronomy 'postdocs'	16	18	34
Regularly employed astronomers	2	9	11

To supplement the information on astronomy graduates presented in **Tables II** and **IV**, we summarized the reported time spent by each group of degree recipients before securing employment. Although the numbers are small, **Table XI**, when compared with **Figure I**, suggests that doctoral astronomers, like physicists at that level, require at least three months to find appropriate employment.